AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. II. No. 1. BOSTON, NOVEMBER, 1902. Ten Cents a Copy.

A KEROSENE BURNER FOR STOVES.

FREDERICK A. DRAPER.

The thought of using kerosene in a coal stove, to many people, is suggestive of strong odors, explosions and other evils, known and unknown. This is generally due to lack of sufficient information and is entirely eroneous when applied to a device correctly designed and managed. Few hesitate to use during the summer months, the excellent oil stoves now obtainable at such moderate cost, and the few accidents that occur through their use are found to be the result of neglect or carelessness easily avoidable. With proper care, which is also needed when coal is used, kerosene can be used with perfect satisfaction in any cook stove and in many syles of heating stoves. The device here described, without some of the improvements, has been in use for several years, and was adopted by the user for its intrinsic value long before the coal strike gave prominence to the fuel question. Unfortunately it is true that several of the oil burning devices recently put upon the market are deficient in many important features, and they will not give satisfaction where used. The information here given will enable the reader to purchase intelligently, if they so desire.

Any device for this purpose should secure the following results; a complete gasification of the oil and the mixing of the gas with a sufficient quantity of air that all the hydro-carbons in the gas may be consumed, thus preventing the formation of soot, odors and the excessive use of oil. Very little yellow appears in the flame from such a device, it being almost entirely blue. In addition must be adequate regulation to obtain a small, medium or large fire as may be required by the various cooking processes. All these features are embodied in the device here described. It can be made by anyone possessing the necessary tools or a plumber can be engaged to do it at the additional cost of his time. The general appearance is shown in Fig. 1, the several parts including an air-tight oil tank, A, equipped with pressure guage, B and air pump C; feed pipe, D, from tank to stop-cock, E, a safety gas check, gasifyer, G, pin valves, H, mixing chambers, J–J^1, and binding staps, K.

The oil tank should be of at least 10 gallons capacity and may be of galvanized iron or copper as may be most conveniently obtained. It should be of heavy enough metal to stand a pressure of 25 pounds, if compressed air is used, which is much greater than is required. An ordinary pressure guage registering to 25 pounds is fitted to the top as shown in Fig. 2, and at the top of the side is fitted an ordinary bicycle pump, connected to the tank by brass tubing or lead pipe $\frac{1}{4}''$ in diameter. The pump is fastened to the tank by metal strips 1″ wide bent around the pump and soldered. The air inlet in the tank is at the top edge of side, so that, when the tank is filled, no oil will run into the pump. The hole, A, through which the tank is filled, should have an air-tight cap to prevent the air which is pumped in and gives the pressure, from escaping. The tank may be located in the cellar or adjoining room or in the same room as the stove, the chief requisite being that the connecting pipe have as few turns as possible and so located that it will not be easily injured. When the situation will allow, the tank can be placed

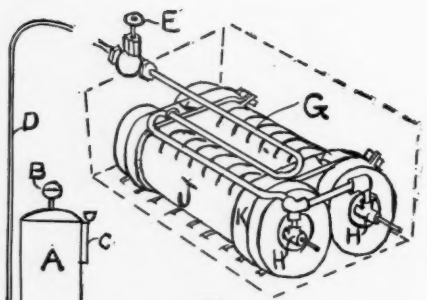


Fig. 1

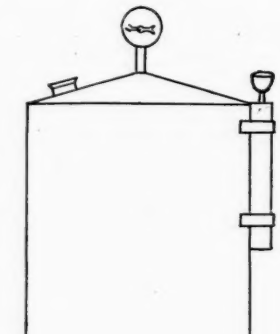


Fig. 2

Fig. 3

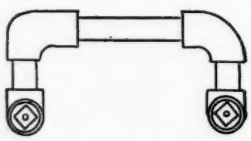


Fig. 4

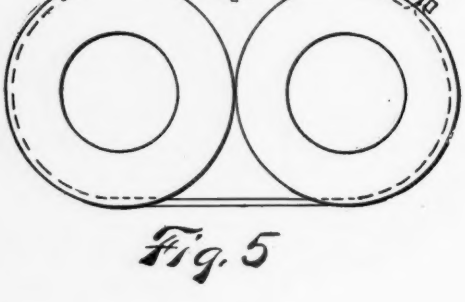


Fig. 5

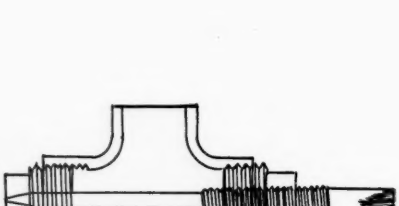


Fig. 6

on the floor above the stove and the oil fed by gravity, in which case no pump or pressure guage is necessary. The feed pipe, $\frac{1}{4}''$ in diameter, is connected to the tank near the bottom, enough space being left so that any sediment in the oil will remain in the tank and not flow into the feed pipe. A union connection is desirable to enable the tank to be easily removed should cleaning become necessary. Either iron or lead piping may be used, the latter being easier to run if many corners are to be turned.

A valve, E, Fig. 1, is placed at the point where the feed pipe joins the burner. As the gasifyer pipe of the burner is $\frac{3}{8}''$ in diameter, a reducing coupling $\frac{3}{8}''$–$\frac{1}{4}''$ is necessary, preferably outside the valve, in which case a $\frac{3}{8}''$ valve would be used. Between the joints on either side of the valve is placed one thickness of brass wire gauge about No. 50 mesh. This forms a safety check, preventing gas or flame from passing back into the feed pipe.

The gasifyer, G, consists of a double U shaped piece of $\frac{3}{8}''$ wrought iron gas pipe about 48″ long, bent as shown in Fig. 3, the outer end projecting outside the stove about 6″. In each of the outer arms is placed a strip of hoop iron $\frac{1}{4}''$ or $\frac{5}{16}''$ wide and 12″ long, which has been twisted into a spiral. This forces the oil and oil vapor to have a longer path, become better heated and gasified. To the front end is threaded a side outlet elbow so placed that one outlet will have a vertical drop and the other open horizontally to the right. A piece of $\frac{3}{8}''$ pipe 2″ long is fitted to the vertical outlet, and a similar piece $2\frac{3}{8}''$ long to the one to the right. At the bottom of the vertical piece is fitted a pin valve made as will be described, the opening in this valve being in the centre of the opening of the mixing chamber, J, Fig. 1.

At the end of the horizontal piece of $\frac{3}{8}''$ pipe, Fig. 4, is fitted an elbow, to which is fitted a vertical piece of the same length as the other vertical piece. To the lower end of this vertical piece is fitted another pin valve. These pin valves do not only regulate the flow of the gas, but enable either side of the burner to be wholly shut off when desired. The inner ends of the pin valves should be $\frac{1}{2}''$ away from the openings to the mixers.

The mixing chambers, J–J^1, are made of heavy wrought or cast iron pipe, $2\frac{1}{2}''$ in diameter and 12″ long. These dimensions are governed by the size of the firebox of the stove. Those here given are for a No. 8 stove and may have to be changed slightly to fit other sizes. By taking a few measurements and drawing a full sized plan on paper the right dimensions can easily be ascertained. The method of closing the ends may be changed to conform to the materials most easily obtained. The back ends are closed with caps or plugs tightly threaded on. The front ends are also fitted with caps or plugs in the centres of which have been drilled holes $1\frac{1}{2}''$ in diameter. On the upper half of each section are sawed slots which should be $1\frac{1}{2}''$ apart, the first one close to the cap and cut nearly half way through the pipe. This can easily be done with a hack saw. The gas-air mixture passes up through these slots and highly heats the gasifying pipe above as well as the rest of the stove. The pin valves previously mentioned emit the gas under considerable pressure, sending it in a jet into the mixing chambers, from whence it passes rapidly through the slots creating a suction for the air and thus drawing into the front opening the air necessary to secure perfect combustion, which is shown by the proportion of blue flame as compared with the yellow part. Not over one-fifth of the flame should be yellow, when the gas and air are in proper proportion, and the nearer all blue the better.

The two sections are firmly held in position by two bands, one at each end, made of bar iron 1″ wide, $\frac{3}{16}''$ thick and 18″ long. These bands are bent as shown in Fig. 5, the ends having $\frac{1}{4}''$ holes drilled in them to receive bolts. Other holes are also bored in the tops to receive $\frac{1}{8}''$ iron hook bolts whith hold the gasifyer in position.

The pin valves, Fig. 6, through which the gas is jetted into the mixing chambers, are made as follows: Two ordindary gas tees, t, as fitted with gas plugs, p, in each of the horizontal openings. A $\frac{1}{16}''$ hole is drilled through the exact centre of the plug nearest the mixer, and a $\frac{1}{8}''$ hole in the outer plug. A $\frac{1}{8}''$ diamond point drill is then run through the outer plug and the inner plug drilled until the point of the drill just reaches the outer edge. The drill points should have a long bevel, so that the hole will be likewise. A reamer may be used in place of the drill. The hole in the outer plug is then tapped to $\frac{3}{16}''$ and a valve rod,

v, made of $\frac{3}{16}$″ stick, is beveled on one end to fit the opening in the inner plug and threaded to fit the outer one. The outer end of the rod, v, is filed square to receive a small T wrench with which it may be turned even when hot. It is evident that this simple valve enables the flow of the gas to be adjusted to a nicety or entirely shut off from either chamber when desired.

The burner, when completed, is placed flat upon the grate of the stove, the fire brick linings at each end having previously been removed from the stove and a hole drilled in the back to admit the end of the gasifyer pipe which projects at the back. Several handfuls of asbestos wool are packed in a roll between the two mixing chambers on the upper side. The connections are then made and the tank filled with oil. Air is then pumped into the tank, if pressure is used for feeding the oil, until the gauge registers five or six pounds pressure, which will be adequate for several hours' feed. The asbestos roll is then saturated with oil, lighted and burned until the gasifyer is well heated. The valve is then opened a little to admit oil which will quickly be converted into vapor. The pin valves are opened slightly, the vapor will then jet into the mixing chamber and with the air pass through the slots and ignite from the flame from the asbestos. The increased heat on the gasifyer will soon supply plenty of gas, and the back valve and pin valves are then adjusted to secure as blue a flame as possible. A little practice will soon show what is required for the best results.

Burning both chambers will give a very hot fire, one chamber, usually the one nearest the water heater, will secure a moderate fire. To burn one chamber, close the pin valve of the other. To relight one chamber, when the other is burning, simply open the pin valve. Should the gas ever burn at the pin valve in place of through the slots of the mixer, close it, then open again with considerable feed. The only time it is likely to do this is when the flame has been turned quite low, and no harm results from it anyway. It is not advisable to try and run very low on this account, run one or both sides at a fair feed, or not at all. Do *not* pour kerosene on the asbestos for relighting while the iron *is still hot from a previous fire*. This is the only precaution to be kept in mind and is emphasized only as a matter of safety which it is well to observe. If necessary to relight soon after a previous fire, have the parts as cool as possible and all covers over the burners removed. This will allow any oil vapor which may be formed to pass out without obstruction, and no harm will result. Should the pin valves become clogged with carbon, remove the rods and clean with a small stick.

To use a burner of this kind in a furnace, the size of the mixing chamber may be larger, or an additional chamber may be added; the first being preferable. A deflecting plate should also be mounted above the burner to throw the flame and heat towards the sides of the fire box. This is made of a circular sheet of boiler iron $\frac{1}{8}$″ thick, the diameter being not larger than one-half that of the fire box, or as large as the door will admit. It is supported by four $\frac{1}{2}$″ bolts, the upper ends of which are put through holes drilled in the plate with a nut on each side. The bolts should be about 10″ long to bring the plate 8″ or 9″ above the burner. The lower ends of the bolts rest upon the binding bands, K, of the burner. Two bolts, threaded at each end may be used, the lower ends being put through holes in the straps, K, with a nut on each side. The hook bolts holding the gasifyer will have to be changed a little to do this. The feed end of the gasifyer will also have to be at the front, the third turn being omitted, and the remaining two turns being placed a little to the inner side of the centres of the mixing chambers.

When cleaning out a steam boiler the lighting of the interior is a very important matter. Oil lamps in a boiler are a danger, being liable to explode, and the explosion of a lamp in a boiler is more series than elsewhere, for it is harder to get away from it. An electric lamp has been designed for use in the interior of a boiler, which can be very easily adapted wherever an electric lighting system is in use. An ordinary incandescent bulb is attached to an insulated, flexible conductor of sufficient length to use it in any part of the boiler. The conductor is attached to the lighting system in the usual way. The bulb is fixed on an electromagnet, so that it can be stuck upon any part of the ironwork, and is covered with wire work to prevent it being broken.

HOW TO MAKE A RHEOSTAT.

WM. J. SLYKE.

If one wishes to control the current from a medical or induction coil, regulate small battery lamps or the speed of small motors, the rheostat or controller here described will prove satisfactory. In many controllers used on medical coils, the graphite resistance is placed in such a position that the controlling switch passes directly over it, wearing the graphite away unevenly and in a short time causing the current to be jerky.

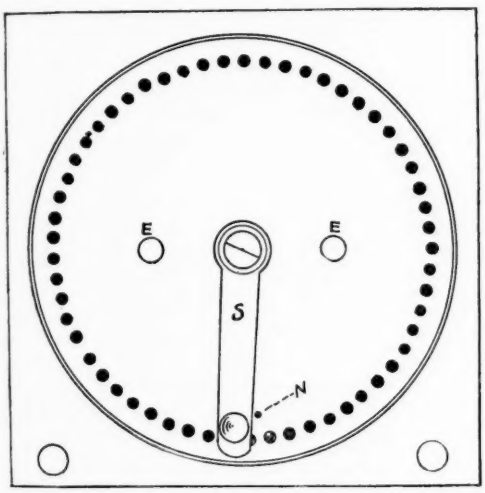


Fig. 1.

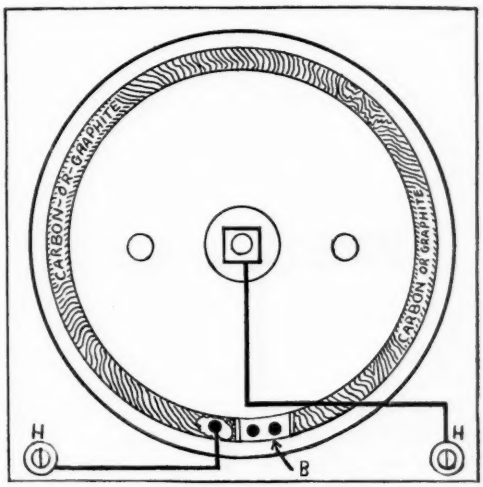


Fig. 2.

Such a faulty device, used in connection with a medical coil, would cause the current to flow all right and increase for a time; then suddenly stop, only to start and give the patient a severe shock, which, if the electrodes were acting on some delicate part, might prove serious. In the one here described this will not occur, as the controlling switch does not pass directly over the resistance path, but passes over metal studs connected with the resistance.

Get a piece of planed hard wood 7″ square and 1″ thick, and with a pair of compasses draw a circle 6½″ in diameter. To improve the appearance the board should be cut around this line, which can be easily done with a compass saw. Smooth the edge with sandpaper. On the opposite side of the board, find the same centre as with the other side, and with the dividers, using the centre just found, draw a circle 6¼″ in diameter. Draw another circle 6″ in diameter. The wood between these two circles should be cut out to the depth of ½″. This groove should be neatly cut out, the sides and bottom being made as regular as possible.

On the other side of the board draw a circle 6⅛″ in diameter. Set the dividers for a trifle over ⅛″ and devide the 6⅛″ circle. Get some small brass headed nails, one for each division mark on the circle. The stem of the nails must be quite small. Put in a nail at each division mark (Fig. 1) of the 6⅛″ circle. The heads of these nails should not touch each other, nor should the stems. By examining the opposite side of the board it will be found that the ends of the nails have come through directly in the centre of the groove. If

they project into the groove more than $\frac{1}{16}''$, cut them off to the proper length, excepting one of the nails which should come through $\frac{1}{4}''$, to which is soldered a wire. The ends of the nails should be absolutely clean.

Through the centre of the block drill a hole large enough to admit a medium size screw, and on the groove side cut out to the depth of $\frac{1}{2}''$ a hole $1''$ in diameter around the centre hole. Bore holes on each side about $2''$ from the middle hole as shown at E, Fig. 1. Get a piece of brass about $\frac{1}{16}''$ thick, $\frac{3}{8}''$ wide and $3\frac{1}{2}''$ long, to serve as a switch (See S, Fig. 1). Drill a hole in one end large enough to admit a screw that will also pass through the middle hole of the block. In the opposite end of the brass strip, drill a small hole. Cut from a round piece of wood, $\frac{1}{2}''$ in diameter, a piece $\frac{3}{4}''$ long, and fasten it in an upright position with a small screw to the end of the brass strip with the small hole. (See Fig. 2.) A small porcelain picture knob makes an excellent handle.

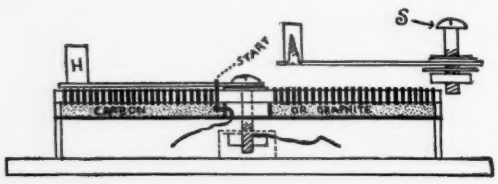


FIG. 3.

From the end of the nail previously mentioned, which projects $\frac{1}{4}''$ into the groove, solder a piece of wire about No. 20 guage and $6''$ long. A piece of thin wood ($\frac{1}{2}''$ in length and wide enough to fit tight in the groove) is inserted in the groove $\frac{1}{2}''$ from this nail. Skipping two or three nails, insert a similar piece of wood. (See Fig. 2.) Now get some graphite or carbon, and fill in the groove to the depth of about $\frac{1}{16}''$, much care being taken not to get any between the two wooden strips. After having put the graphite in the groove, press it down as tight as possible. Cut a piece of cardboard the same shape and size as the groove, omitting the space between the two wooden strips. Lay it over the graphite, seeing that it everywhere touches the graphite. Melt some sealing wax in a dish, and when melted, pour it all around the groove including the space between the two wooden strips. This wax should come nearly up to the edge of the groove.

Now take the brass handle and centre screw, push a washer over the screw, and put the screw in the large hole of the brass switch. Then put the screw in the centre hole of the block, put on a washer, then a piece of wire $6''$ in length, and tighten the whole with the nut. The swite hshould make perfect contact with the heads of all the nails, and turn without difficulty. Another piece of board for a base $7''$ square is required, and holes are cut in two corners to admit the binding posts, H–H, Fig. 2. The rheostat is screwed to this base hard by screws put through the two holes, E, E, Fig. 1, the wires being carried through two small holes drilled in the base, and then run in grooves cut on the under side to the binding posts, Fig. 2. Before putting in the sealing wax, notice should be taken of the nails that do not make contact with the carbon, and when "resting," the switch should always be on these heads, as this is the starting point. A stop, N, Fig. 1, made of a small nail hammered in the wood is useful, as this will always tell when the current is on full or when completely off.

This rheostat should be placed on the positive pole of motor, coil, or whatever electrical device it is used with.

For several years petroleum has been used extensively in Germany to remove scale from steam boilers. The oil was introduced with the feed water. When the water was drawn from the boilers, the oil, floating on top, would be deposited on the scale and dissolve it. There was no thought of danger in connection with the operation, but in a recent report issued by the government, attention is called to several accidents that have resulted from this method of boiler cleaning.—Ex.

CAVES in limestone formation are being used as resorts for those afflicted with pulmonary complaints. The even temperature of the air and freedom from germs and dust are additional advantages. The "cave cure" may soon be a regular thing for physicians to direct.

STUDIES IN ELECTRICITY.

XIII. THE MOTOR.

The motor is a machine which converts electrical energy into mechanical energy; the reverse of the dynamo. Most forms of these machines may be run either as a dynamo or a motor, so much alike are they in construction. The dynamo generates a current by the rotation of a conductor (the armature) in a magnetic field. In the motor, the conductor (armature) tends to cut the lines of magnetic force whenever excited by a current. Thus we have motion and this motion is made continuous by providing a sufficient number of conductors (coils) in the armature to maintain a constant "pull" upon it. This tendency of the armature to turn is known as the *torque*, which is proportional to the current supplied from the mains and would be absent without the current, even were the field magnets fully excited.

The rotation of the armature of a motor in a magnetic field generates therein an E M F just as would be the case with a dynamo, but with the motor the E M F is counter or opposed to the current being supplied the armature. When a motor is started, this C E M F is small but as the speed increases and the coils of the armature are cutting an increasing number of magnetic lines of force, the C E M F rapidly increases until the maximum speed of the motor is reached. The effect of this C E M F is to reduce the amount of current received by the motor, and is also an important factor in determining the speed of the motor. Assuming there is no load, the armature of a motor will rotate at such a speed as will generate a C E M F which, together with the current required to overcome the armature resistance, will equal the E M F supplied the motor. Under a load, however, the current supplied the armature must be increased, which occurs through a decrease in the speed and resulting C E M F. It becomes evident also that the winding of the coils of the armature has a close relation to the speed. A slow speed is obtained by using many coils of fine wire, thereby requiring few revolutions to enable many lines of magnetic force to be cut. Increasing the size and reducing the number of turns of wire in the armature, increases the speed; likewise if the strength of the field be reduced the speed will be increased, as only in this way can the necessary number of lines of force be cut by the amature windings. Increasing the current supplied the motor will also increase the speed, and therefore the reverse is also true.

The field windings of a motor vary as do those of a dynamo, the direct current motors having three general types; series, shunt and compound windings, as illustrated by Figs. 27, 28 and 29 of the dynamo. The use of series motors is now confined largely to street car service and the operation of certain forms of machinery where variation of speed under varying loads is not objectionable. Refering to Fig. 27 illustrating the path of the current of a series dynamo, it will be seen that the current which excites the fields also traverses the armature. Under a light load, the current required will be small as will be the resulting M M F of the fields. The speed of the amature will therefore be high, as there is nothing to retard it. If the load be increased, the torque will be greater, the current will increase as will also the M M F or flux through the amature, and the speed will be decreased. The advantages of this type of motor are: ease of starting under a heavy load, less cost of manufacture because of simplicity of construction, and ease of operation. The disadvantages are; variation of the speed with the load, which may become dangerously excessive should the load be suddenly or entirely removed.

The shunt-wound motor illustrated by Fig. 28 of the dynamo, has the advantage of practically a constant speed, when the current is constant and the load variable. The method of winding requires that, in starting, the current be increased gradually with the increase in speed. It is customary therefore to introduce into the armature circuit a starting resistance in the form of a rheostat, which prevents an excessive current from flowing to the armature when starting. This type of motor

is in general use in operating many kinds of machinery where a constant speed is necessary. The greater cost of construction makes the selling price somewhat higher than for the other type.

The compound-wound motor, as illustrated by Fig. 29 of the dynamo, has the advantage of constant speed under varying loads, and is used where the motor is frequently stopped and started.

The efficiency of motors is less with small than with large motors. A small fan motor will not develop an efficiency much greater than 40 per cent., while a 100 H P will reach about 90 per cent., and it will be even greater in larger sizes.

The energy used in operating a motor is measured and expressed by *kilowatt* hours, one kilowatt hour being the energy expended in one hour when the activity or power is one kilowatt.

HOW TO MAKE A TELEPHONE.

NEWMAN H. HOLLAND.

II. THE SWITCH AND OTHER PARTS.

The arrangement here given assumes that an ordinary electric bell is used for the ringing devise, and that this bell is mounted on a baseboard outside the case containing the transmitter, switch and other parts. The baseboard should be of a size to extend beyond the case $\frac{1}{4}''$ at the sides, $\frac{3}{4}''$ at the bottom and give $\frac{1}{4}''$ margin around the bell at the top. The top may be cut in as shown in Fig. 2, or left square, the former presenting a little neater appearance.

The switch rod, S, is made of a strip of brass $4\frac{1}{2}''$ long, $\frac{3}{8}''$ wide and $\frac{1}{8}''$ thick, the outer end being filed to the hook shape shown, to hold the receiver, and projects, when in position, through a slot cut in the left side of the case. A $\frac{3}{16}''$ hole is drilled $\frac{1}{4}''$ from the inner end to receive a round head brass screw, which holds the switch in position. A washer is placed between the head of the screw and the switch rod. Another small hole is drilled $1\frac{3}{4}''$ from the inner end and on the upper edge to receive the end of a strong brass spring, M, the upper end being attached to a round head brass screw, so placed that the spring will draw up the switch rod when the receiver is removed and yet allow the rod to fall when replaced. Three strips of spring brass, a, b and c, $1\frac{1}{2}''$ long and $\frac{1}{4}''$ wide, are also required for the switch and are placed as shown in Fig. 2. Holes are drilled $\frac{1}{8}''$ from the ends to receive small round head brass screws. The other ends are curved slightly so they will pass the switch rod when the latter is raised or lowered. The two pieces, a and b, are placed $\frac{1}{4}''$ apart, and so that a good contact is made with the rod, S, when receiver is removed. The piece, C, is so placed that a good contact is made with the rod, S, when the receiver is replaced. These pieces should not touch the rod when the latter is in the opposite position to that which should give contact. The screws holding the rod and contact pieces should be long enough to enter a short distance into the baseboard.

The ringing switch is made as follows: A piece of spring brass, R, $2\frac{1}{2}''$ long and $\frac{3}{8}''$ wide, is bent near the end so that the greater part will be about $\frac{1}{4}''$ away from the side of the case. A hole is drilled in the short part to receive a round head brass screw which holds it in position. A washer is placed under the head of this screw. Bore a $\frac{3}{8}''$ hole through the side of the case to receive the head of a wood or porcelain button, B. Those found in push buttons will answer nicely for this purpose. A small piece of spring brass, P, is bent to the shape shown and fastened with small brass screws. The point of this piece should be in contact with the spring, R, when at rest, but not when pressed forward into contact with L. Another piece of brass, L, is bent L shaped, a hole being drilled in the foot to receive a small round head screw. This piece is so placed that it will clear the spring, R, except when the latter is pressed forward, and yet not so far away that the button can fall out when pressed.

A small induction coil is placed in the upper part of the case as the instrument will give better

service if provided with such a coil. They can be purchased at so low a price that nothing can be saved by making them, so no description will be given other than to say that for service over

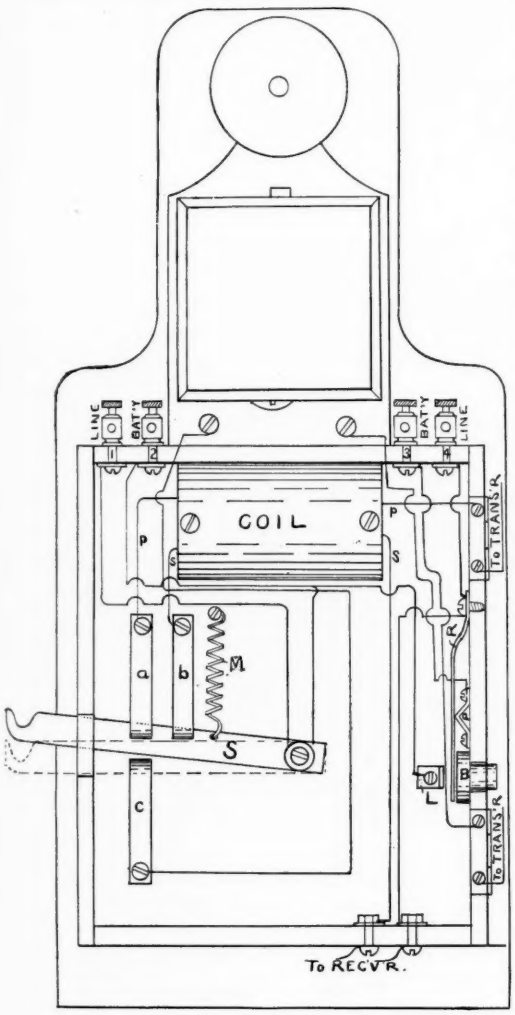


FIG. 2.

moderate distances, 150 ohms resistance will answer, for longer distance get 250 ohms. Four binding posts are placed on the upper side of the case as shown, for connections, but round head brass screw bolts may be used if posts are not obtainable. Two brass screw bolts are also needed on the under side of the case for connecting the wires to receiver.

The parts above described being completed and assembled, the bell in position, the connections should be make with No. 18 cotton covered magnet wire as shown in Fig. 2. Connect one terminal of secondary winding of coil to left screw bolt at bottom of case; connect the other screw bolt to screw holding ringing key, R, and also connect this screw to binding post No. 4. Connect one terminal of primary winding of coil to switch spring, a, and the switch rod to binding post No. 1. Binding post No. 2 is connected to the front contact, L, of the ringing key, and also with the switch rod by branch or direct wire The back contact, P, is connected to one terminal of bell. Connect binding post No. 3 with one screw in the lower hinge holding the cover to which the transmitter is attached, and the other hinge with the other terminal of primary winding of coil; the other terminal of secondary coil being connected to switch spring, b. The remaining terminal of bell is connected to switch spring, c. The lower hinge is connected to the diaphragm of the transmitter, and the upper hinge to the bolt of back carbon, and the interior connections are complete. All joints should be soldered, using soft solder and a blow torch. Simple contact joints will oxidize in time and poor service result.

The line connections are as follows: The line wires are connected to binding posts, 1 and 4; the battery, consisting of two cells for each instrument, with binding posts, 2 and 3. The zinc post of one cell of battery is connected to carbon post of the other cell, one battery wire being taken from the remaining zinc post and one from the carbon post. The receiver will be described in the next chapter.

IT is a fact that boilers are in use that are only fit for scrap iron, and in some cases with men in charge who, by inexperience or laziness, are daily risking both life and property. It is impossible, even with the best care and the most expert attention, to prevent all boiler explosions, but there would be less of these disasters if inspection was more conscientious, and the men in charge always what they ought to be, both in practical knowledge and honest vigilance.

AN ELECTRIC HAND LAMP.

Fred W. Russell.

The electric hand lamp here described is easily constructed and will be found very convenient for use about the house, stable or shop. As it can be held in any position, it is quite useful in dark corners or closets, and as a night lamp is always ready and instantly lighted by moving the switch. and a brass handle for carrying. It is divided in the centre with a wooden partition, B. On the front of this partition is attached with small screws, a small metal reflector. This may be obtained at small cost of about any well equipped lamp dealer.

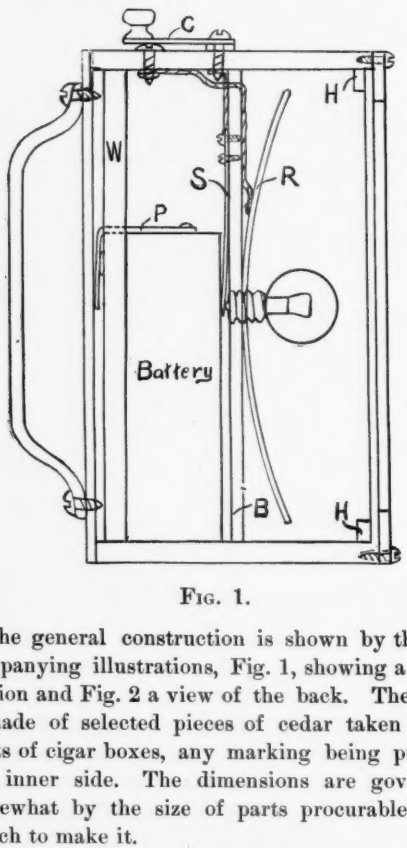


Fig. 1.

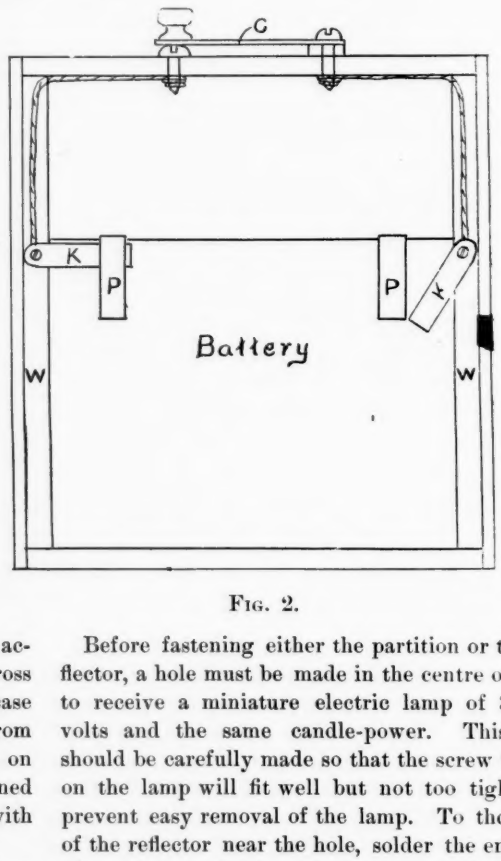


Fig. 2.

The general construction is shown by the accompanying illustrations, Fig. 1, showing a cross section and Fig. 2 a view of the back. The case is made of selected pieces of cedar taken from parts of cigar boxes, any marking being put on the inner side. The dimensions are governed somewhat by the size of parts procurable with which to make it.

Batteries are made especially for this purpose and if this kind is used, the dimensions here given will be suitable for most makes. The case outside is 4½″ high and wide, and 3″ deep. The back is hinged and fitted with a catch at the right side

Before fastening either the partition or the reflector, a hole must be made in the centre of each to receive a miniature electric lamp of 3 or 4 volts and the same candle-power. This hole should be carefully made so that the screw thread on the lamp will fit well but not too tightly to prevent easy removal of the lamp. To the back of the reflector near the hole, solder the end of a piece of covered wire, No. 18 guage and 6″ long. Use soft solder and soldering fluid, being careful not to use so much heat that the polished surface of the reflector is damaged. The base of the lamp should project but slightly through the back of

the partition. In the centre of the base of the lamp will be found a small projecting zinc, which forms one pole of the lamp.

A piece of thin spring brass, S, 2″ long and ¼″ wide, is fastened to the rear side of the partition with one screw at the top end. The lower end should just pass the centre of the hole in the partition, so that, when the lamp is in place, this brass strip will be in contact with the center pole above mentioned, but not touch the outer brass screw part of the lamp, as the battery would be short circuited if this happened. Having obtained a battery suitable for the lamp, place it temporarily in the back part of the case. Cut out strip of wood, W, to fit on either side of the battery. These strips should not be less than ¼″ thick, ⅜″ is better. They should be glued or nailed to the sides of the case so that they will be just flush with the outer side of the battery, which has two brass strips or poles, P, projecting downward on one side. This side should be placed outward. Two thin strips of spring brass, K, 1¼″ long and ¼″ or ⅜″ wide, are fastened at the ends (which must be rounded) to the two pieces of wood just mentioned, so that they can be moved to make contact with the inner side of the poles, P, of the battery. This is shown on the left side of Fig. 2. When the battery is removed, these strips are turned downward until they clear the battery. Short pieces of covered wire are soldered to the ends of these pieces for connections.

The switch, C, is made of a piece of spring brass 2″ long and ⅜″ wide, with $\frac{3}{16}$″ holes in each end. To one end is attached a small wooden or porcelain knob, the other end being held by a round head brass screw. A thick washer is placed under the brass strip to lift it away from the case and slide easily onto the top of another brass screw, placed in the case so that the movable end of the brass strip can make a good contact with it. File the top of this screw slightly to make a flat top, which will give a better contact. The brass parts of a plain two point switch may be used to give a better appearance.

The wire connected to one of the brass pieces, K, is carried to the end of one of the screws of the switch and soldered. The screw holding the brass strip, S, is connected with the other piece, K. The wire from the reflector is connected to the remaining screw of the switch. It is evident that if the brass piece of the switch be placed in contact with both switch screws, a circuit will be formed and the lamp will be lighted. Opening the switch breaks the circuit and turns off the light.

The front of the case is a plain piece of wood with a round hole in the centre, slightly smaller than the reflector. It is fastened by several small round head brass screws, as it has to be removed whenever a new lamp is required. A piece of plain glass is placed behind the front board, being held by small strips of wood, H, glued to the case. A coat of varnish and some ornamental brass trimmings will give the case quite an attractive appearance. Remember to shut off the current when the light is not needed, thus prolonging the life of the battery.

PLATINUM.

The fact that the production of platinum is not increasing as rapidly as is its consumption is causing considerable concern in many lines of work. Unless new sources of supply are discovered, and this does not seem probable, or a satisfactory substitute is found, certain branches of the electrical industry will be unable to secure the requisite quantities for their work and will be seriously handicapped.

Nearly all the platinum mined today comes from Russia. While this metal is found in small quantities in the United States, it has not been found to pay for extracting it. The depossit in New South Wales promise better, and it is to be hoped that mining will soon be begun there on a suitable scale.

In the meantime, it might pay if some of our inventors would turn their attention to finding a suitable substitute for this costly metal. A careful study of alloys might result in a valuable discovery.—*Electrical Review.*

Dr. H. F. Parker in the *Medical Times* states that a person frequently stung by bees may eventually become immune against the poisonous effects of the stings. The first stings will produce the usual effects, but then gradually reduce in severity until, when the system has become innoculated with the poison, little or no effects are produced even when the stings are numerous.

AMATEUR WORK

63 KILBY ST., BOSTON

DRAPER PUBLISHING CO., PUBLISHERS.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS.

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter, Jan. 14, 1902.

NOVEMBER, 1902.

Contents

A KEROSENE BURNER FOR STOVES *Frederick A. Draper* 1

HOW TO MAKE A RHEOSTAT . *Wm. J. Slyke* 5

STUDIES IN ELECTRICITY:

XIII. The Motor 7

HOW TO MAKE A TELEPHONE:

II. The Switch and Other Parts *Newman H. Holland* 8

AN ELECTRIC HAND LAMP *Fred W. Russell* 10

WOOD TURNING FOR AMATEURS:

III. Sharpening the Tools *F. W. Putnam* 13

AN IRONING RACK . . *John F. Adams* 17

SIZES OF CONE PULLEYS 18

PROJECTION:

III. Prisms 19

FINISHING NATURAL WOODS *F. W. Putnam* 21

MANUAL TRAINING SCHOOLS.

THE growth of manual training schools, both in size and number, throughout the country is a matter destined to bear important results as the work of these schools becomes better known and appreciated. To the young man who has no taste for a classical education, the opportunities presented by the manual training school should receive most serious consideration. The pupil who has faithfully completed a course in such a school, cannot fail to have acquired a knowledge of great practical value in after life, no matter what vocation he may eventually follow. As a help to developing latent talents, no scheme of education yet devised is the equal to it.

It is this latter phase of the subject which requires to be strongly emphasized. How frequently, almost universally, do we hear men of mature years speak with regret of having failed to select in early years, a more suitable vocation; one to which they would have been better suited by nature than the one they followed. At best, it is a very difficult problem to determine what shall be our life work, and for that reason, our early education should help in every possible way to show what nature has fitted one best to do. This selection can be made less difficult if early attention is given to school work, and the advantages of the several courses carefully examined.

As yet, manual training courses have not been developed to any great extent in the smaller cities and larger towns, but some arrangement for doing this must be made, if the educational facilities of these places are to keep pace with the standards now demanded for the yonth of the country. This will surely follow when those interested are alive to the great benefits to be derived from their introduction.

A feasible way of solving the problem would seem to lay in schools supported by the county, or by groups of adjacent towns with convenient transportation facilities. The expense would then be distributed, and at the same time, a sufficient number of pupils secured to make workable classes. Those of our readers who are desirous of advancing this form of educational work should see that its advantages are fully and frequently presented to the proper authorities, that their attention may be drawn to it and steps taken to obtain it.

WANT of care does more damage than want of knowledge; hence care and knowledge should be well commingled. It is easier to form a habit than to break one off; therefore we should strive to form correct habits.

Renew your subscription promptly.

WOOD TURNING FOR AMATEURS.

F. W. Putnam, Instructor Manual Training School, Lowell, Mass.

III. SHARPENING THE TOOLS.

The sharpening of tools is necessary to their proper management and use, and this is especially the case with good tools, where quality may be very much discounted by allowing them to become blunt. Of all the tools of the workshop, whether for the amateur or of the practical man, the absence of the grindstone would be the most severely felt. Without it the restoration of the edges of the tools would be scarcely possible, and upon their perfection much of the practical success of cutting processes depends.

Sharp tools produce, with the least expenditure of time, surfaces so nearly finished as to require but little polishing, whereas blunt tools leave the lines and mouldings less accurately defined, and the excessive use of sandpaper, or any other such method of removing the defects, makes a bad case worse, obliterating all the keen edges that give to the work a defined and exact character.

The primitive tools, whether of stone, wood, bone, or metal, were probably sharpened by rubbing them on flat, gritty stones, a method still used in the absence of other means; although when the substances are hard, and much is required to be ground away, it is very tedious.

A grindstone rotating upon an axis was introduced about the same time as the potter's wheel. Since that time there has been a steady advance in the machines for grinding, and today there are many types of grindstones and tool grinders on the market, the latter being great labor and time savers.

The restoration of the edges of most cutting tools for wood is effected by the successive action of the grindstone and oilstone, the former being employed to remove the principal bulk of the material, so as to prepare the tool for the action of the slower but more delicate oilstone, which produces a much keener and more accurate edge than can be obtained with the grindstone.

The grindstone should be kept in order so far as possible by the equal distribution of wear; narrow tools especially should be moved constantly back and forth across the face of the stone to avoid wearing the latter into ridges, and the extreme edges of the stone should be exposed to their fair amount of work, or otherwise the stone will become hollow and unfitted for grinding broad flat tools.

The stone is turned either to or from the operator according to circumstances. In all practical cases it should run towards the extreme edge of the tool, and not from it, as in the latter case the last portion bends away from the stone and leaves a film or *wire edge* upon the tool, which the reversed direction avoids.

The edges of the tools should always be ground parallel to the axis of the stone, or *transversely*, and not in the direction of their length, as the former position makes their edges keener, straighter, and better prepared for the action of the oilstone.

The sharpening of the cutting tool is not an operation which can be satisfactorily performed at a first trial, and to grind the various tools with a uniform bevel requires considerable practice, as of course the least variation or trembling of the hand makes a corresponding irregularity in the bevel. After a time however the fingers acquire considerable sensibility and readily appreciate when the tool lies fair and flat upon the stone.

The tools most generally used for turning the soft woods are the gouge and side tool or skew chisel. The turning gouge is ground externally and obliquely, so as to make the edge eliptical, and it is principally the middle portion of the edge that is used. The chisels are ground with bevel on both sides, and at an angle of from 25° to 35° for soft, and 40° for hard woods. The basil or bevel of the side tool should be even all its length, and not made more obtuse as it approaches the cutting edge. This is a very important point, and one that the beginner should not fail to attend to, as on a correct shape of the gouge or side tool depends the quality of the work.

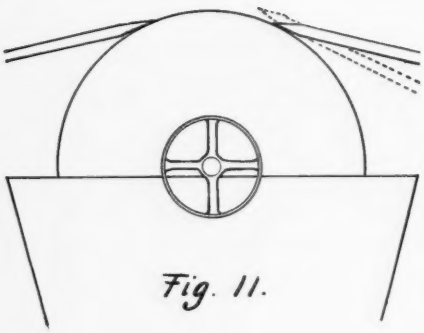


Fig. 11.

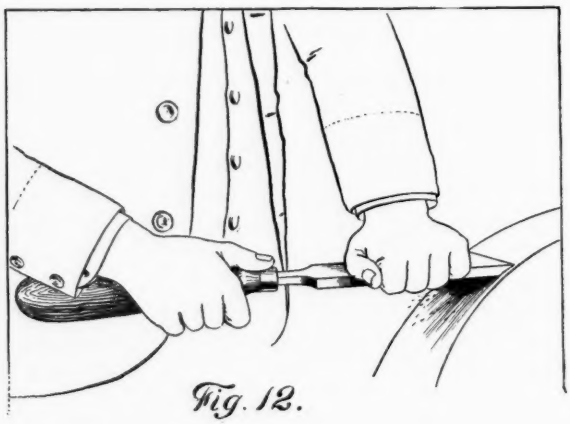


Fig. 12.

Fig. 14.

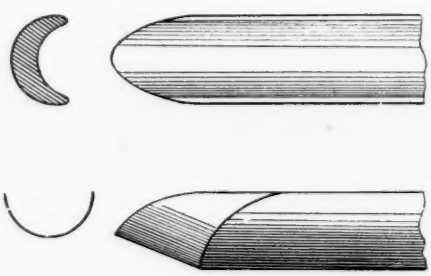


Fig. 15.

Fig. 16.

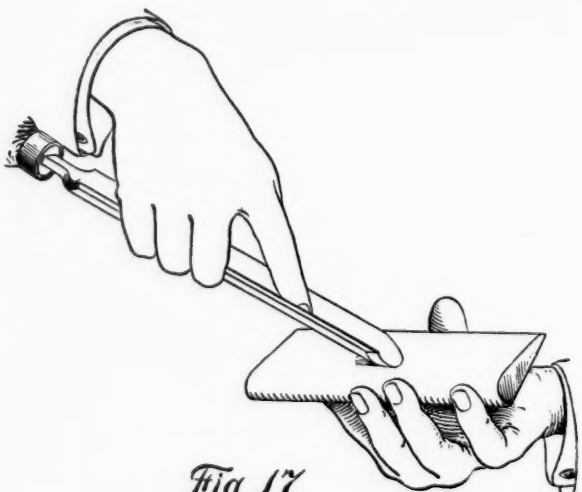


Fig. 17.

Grinding the Side Tool or Skew Chisel.

In grinding this chisel the stone should revolve towards the operator. The handle is grasped with the right hand, while the pressure is applied with the fingers of the left. The shaft of the chisel must be held at an angle in order to bring the edge square upon the grindstone. It is advisable to first place the side tool so that the cutting edge is clear of the stone shown by the dotted lines in Fig. 11, and then draw the tool back to the position shown by the solid lines of Fig. 11, with the bevel resting on the stone. If the side tool is brought against the stone in this manner, the danger of touching the cutting edge against the revolving stone and thus still further dulling the tool, is avoided. Move the side tool slowly back and forth across the face of the stone, being careful not to give any rocking motion to the tool, as this will round the bevel. When the chisel is

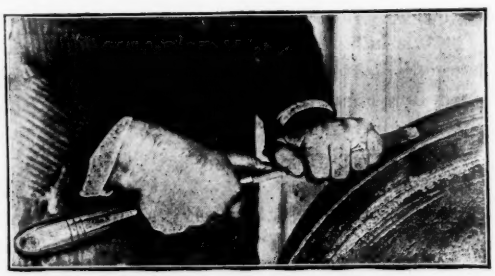


Fig. 13.

turned over to grind the second bevel, of course the angle at which the shaft is held must be reversed. When the bevel has been made perfectly straight down to the edge, stop grinding and finish the sharpening of the tool on the oilstone. If ground still more, the edge will become bent over, forming what is known as a *wire edge*. This wire edge is worn off on the oilstone, a description of the method being given later in this article. Fig. 12 is a sketch showing the position of the hands in grinding the side tool. Fig. 13 is taken from a photograph and also shows very clearly the method employed in grinding this tool.

Grinding the Turning Gouge.

In grinding a turning gouge, which requires an elliptical edge, the stone generally travels from the operator. The elliptical cutting edge is necessary to prevent the corners catching the work, and to permit the gouge to be moved in less space in turning small curves and mouldings; for which latter reason, this shape is perhaps carried to a rather greater extent with the smaller sized tools. The tool is held much the same as a turning chisel, except that the oblique position of the shaft is uncalled for except in grinding the ends of the elliptical curve. To give the elliptical form to the edge, the gouge is twisted in the hand half a turn backwards and forwards, and it is at the same time moved across the face of the stone, not in a straight line as for most tools, but in a semi-circular path like an inverted arch, the sides of the gouge being applied nearer the top of the stone than the middle of the gouge. Be careful that the elliptical curve is ground evenly out to the ends, and that the bevel be perfectly straight down to the cutting edge. Do not hold the gouge too low down on the grindstone, as the bevel may become too short.

The parting tool is generally about one-eighth of an inch or less in width at the cutting edge, the widest portion of the blade. This sometimes tapers gradually thinner towards the thicker stem to obtain clearance in the work. In grinding this tool, be sure that both bevels are ground perfectly straight down to the cutting edge, and not rounded over, as may be the case if the hands are not held firmly during the grinding process. Fig. 14 shows the proper form to grind a gouge, while Fig. 15 shows views of the gouge ready for use.

Sharpening Cutting Tools on the Oilstone.

The completion of the edges of the tools after grinding is effected either upon the Washita stone or the Turkey stone. These stones differ exceedingly in quality, some being so hard as scarcely to take any hold of the tool, while others are altogether too soft for use with small tools. The latter are best for broad tools, as they cut rapidly and are then less exposed to being irregularly worn than when used for narrow tools. The choice of a stone is somewhat perplexing, owing to the great variety in the market. The best stone for general purposes is the Washita. It is of a light grey color, almost white, and in choosing this or any other stone, a good even color and texture, with an absence of veins, flaws, or shells, should be looked for. This stone should be quick cutting

in its action, and its quality in this respect may be roughly tested by running the edge of a finger nail down the surface once. If a good stone, the nail will be noticeably worn, and on the stone itself a very slight impression should be made, a fine hair like scratch appearing. The Turkey stone is an exceedingly good kind, but not so fast cutting in its action as the preceeding. On the other hand, it gives an even finer edge on the tool. It is of a creamy, opaque, yellow color. The Arkansas is a fast cutting stone, and gives an excellent edge, but its price is quite prohibitive. Stones are usually about 8″ to 12″ long by 2″ to 3″ wide and 1½″ to 2″ thick.

To assist in the cutting of a tool edge, oil is poured in small quantities on the stones. Use only good clean oil not disposed to dry; otherwise it becomes thick, like glue or varnish, and entirely prevents the action of the stone upon the tool. When not in use the oiled surface is very apt to accumulate any foreign gritty matter which may be floating in the air, and which will wear both tools and stone unevenly. To prevent this, the stone should be set firmly in a piece of wood, and a lid made to fit over it. The lid should invariably be put on when the stone is not in use.

In rubbing the tools on the oilstone it must be remembered that it is as important to wear away the stone evenly as it is to hold the tool properly, for if the surface of the stone becomes hollow in the middle, it necessarily makes round cutting edges on the tools instead of straight ones. In sharpening, and especially on fast cutting stones, the extreme edge is not entirely removed, but, owing partly to the pressure on it and to the slight resistance to the forward movement offered by the stone itself, a very small portion is turned up, and when examined this *wire edge* will be visible, though perhaps the tool may be quite sharp. In order to remove this *wire edge*, draw the edge of the tool through a notch cut by itself in a piece of soft wood, after which a few touches on the oilstone will render the edge perfectly keen and fit for use.

It has been explained that some practice is required to enable one to hold the tools steadily upon the grindstone at the proper angle; the same remarks apply to setting tools upon the oilstone, but in the latter case the difficulty is increased by the necessity for rubbing the tools backwards and forwards upon the oilstone. With a little care and practice, however, the hands acquire the habit of traversing the tool at the same angle in parallel lines. This is quite essential for should a rocking motion be given the tool in the direction of the bevel, during the stroke, the beveled surfaces, instead of being flat, would become rounded, and the ultimate edge of the tool would be thereby thickened and unsuited for its porpose. In holding the side tool upon the oilstone, raise hand until the oil begins to ooze out from under the cutting edge of the tool. This will happen when the under bevel is bearing evenly on the surface of the stone. If the same position of the hands be maintained through the sharpening of that side of the tool, the bevel must remain straight. Fig. 16 shows the position of the hands when sharpening the side tool on the oilstone, the left hand bearing down on the end of the side tool, and the left hand holding the handle.

The turning gouge, when sharpened on the flat oilstone, is held in the right hand and the tool moved in a concave sweep across the face of the oilstone, while the gouge is twisted in the hand exactly as described for grinding this tool. Sometimes the outside edge or bevel is sharpened with an *oilstone slip* which is a Washita stone, generally about 4″ long and 2½″ wide, with rounded edges tapering from about $\frac{5}{8}$″ thick down to $\frac{5}{16}$″ thick at the opposite edge.

The round edge is used on the inside of the gouge to take off the wire edge. When this is being done, take care that the slipstone has a bearing surface along its whole edge on the inside of the gouge. The tool is generally held firmly in the left hand and the slipstone moved back and forth. Fig. 17 shows the method of using a slipstone, the right hand in this case holding the tool, the slipstone being moved with the left hand.

The first exercises to be taken up are the production of the simple planes and solids. The manipulations acquired in turning these forms may be readily applied to many others, more complex in shape or to detailed ornament.

Each exercise involves the use of some new tool or the working out of some new principle in turning. As all of these different elementary

principles will be applied later to a set of useful exercises, the exercises which follow must not be thought of as simply exercises, but as necessary steps, leading to more advanced work.

All of the hand turning tools may be considered to contain the principle of the lever; their cutting edges are at their shorter ends, the rest on which they are supported is the fulcrum, and their handles or shafts are the longer ends. The distance from the fulcrum to either end can be varied easily by changing the position of the centre rest, and that of the hand on the shaft of the tool. It will be found that the more closely the rest is placed to the work, and the nearer the hand to the end of the handle, the greater will be the power obtained, and the less the strength required.

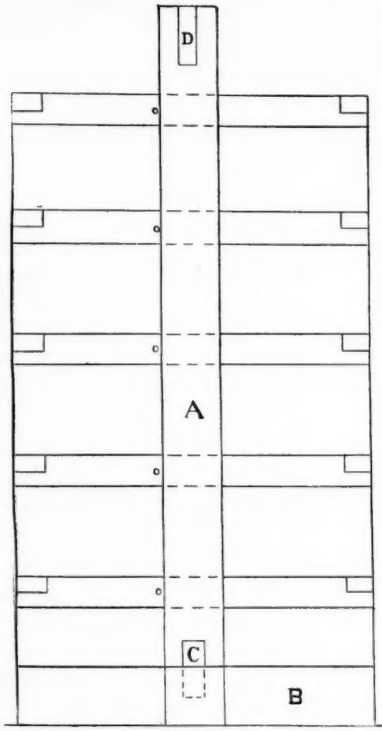


Fig. 1.

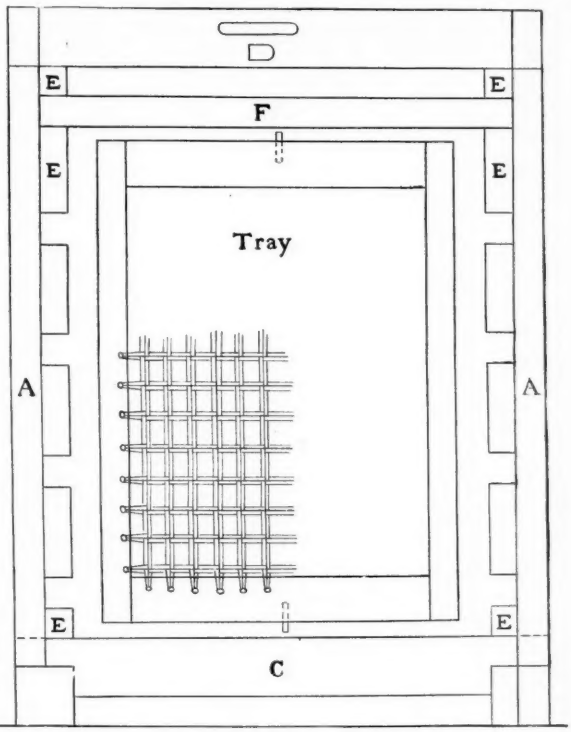


Fig. 2.

AN IRONING RACK.

John F. Adams.

During a recent visit at the home of a friend who is rather handy at getting up things for the house, I was shown an arrangement for holding the numerous small things that usually form a part of the family ironing. It seemed to be such a useful and convenient device, and so easily made, that a description of it will probably interest some of the readers of this magazine. Almost any wood, harder than pine, will be suitable to use, white wood, maple or birch probably being the best for low cost woods. Two pieces, A, 24″ long, 2″ wide and $\frac{7}{8}$″ thick; two pieces, B, 12″ long, $1\frac{3}{4}$″ thick and 2″ wide; two pieces, C and D, 20″ long, 2″ wide and $\frac{7}{8}$″ thick; will be required for the frame. Also eight pieces, E, 2″ long, 3″ wide and $\frac{3}{8}$″ thick, and four similar pieces, E, 1″ wide. For the trays, ten pieces 18″ long, 1″ wide and $\frac{1}{8}$″ thick; and ten pieces, 12″ long, $1\frac{1}{2}$″ wide and $\frac{1}{8}$″ thick.

Mortises $\frac{7}{8}$″ square are made in the center of pieces, A, 2″ from the lower end, and at the upper end, mortises 2″ long and $\frac{7}{8}$″ wide, are cut. The lower ones receive tenons cut in the ends of the

cross-pieces, C, which are cut to fit around the pieces, B, as shown in Fig. 2. The ends of the piece, D, fit the mortises cut in the upper ends of pieces, A, the joints being secured by gluing and dowels made from beef skewers. The pieces, E, are glued to the inside of the uprights, A, with the grain of the wood horizontal or crossing that of A. The space between them should be just enough to allow the trays to slide easily but not loosely. The pieces, B, are halved to receive the lower ends of pieces, A, being fastened with glue and screws from the inner sides. On the top of the cross-piece, D, is screwed an ordinary iron door pull to enable the rack to be easily moved.

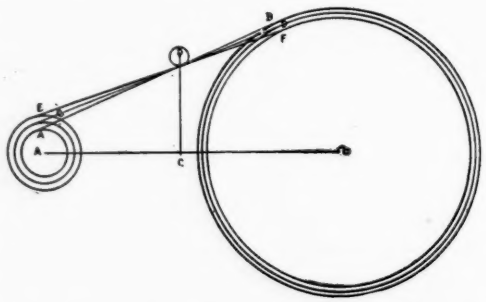
The trays, five in number, are 18″ long and 12″ wide, the joints being halved and strongly glued. All around these frames $\frac{3}{16}$″ holes are bored, $\frac{5}{8}$″ apart. Several frames can be held together with hand clamps and the holes in them bored at one time, greatly reducing this part of the work. Cane, such as is used for seating chairs, is then woven across between the holes, the diagonal weave being omitted. By examining a cane seated chair, the method can be quickly learned. This gives a firm, level surface, with plenty of open space to facilitate airing and drying of newly ironed things, such as napkins, handkerchiefs, etc.

When the trays are completed, place them centrally in the frame and mark on each end a place for a stop. These are made of short pieces of skewers, tightly fitting in holes bored to receive them and keep the trays in position when moving about.

SIZES OF CONE PULLEYS.

An amateur sometimes finds it necessary to determine the diameter of the different steps of a cone pulley to run with another cone, the steps of which are of known dimensions; a single belt to be used, which will fit equally tight on each step. This is an easy matter when the distance between centers of the two cones is greater than four times the diameter of the largest step; i e, when the distance between pulleys is great enough to make the going and coming parts of the belt run nearly parallel to each other on the centre step. In such a case, fix upon the size of one step for the unknown pulley, either the smallest or largest as may be most convenient, and which will give the proper speed. Sum the diameters of this step and the corresponding step on the known pulley, and using this as a constant, add or subtract the diameters of the other steps of the known pulley to obtain the steps of the other.

Should the distance between centres be less than as above stated or the sizes of the pulleys differ greatly, as with the drive wheel and cone of a foot-power lathe, a different method must be used. To obtain dimensions of minute accuracy involves formula that many readers of this magazine would be unable to use satisfactorily, so a more simple method is given which will, if carefully followed, give results sufficiently accurate for all practical purposes.



For illustration, assume a three step cone on the head stock of a turning lathe, the diameters being 2″, 3½″ and 5″, respectively, to be driven by a pulley, the largest step being 20″ diameter and 21″ distance between centres of the two pulleys.

Draw to scale, full size or as near it as possible, on a flat, smooth piece of suitable paper, a diagram, giving known dimensions as follows: Draw the horizontal, A–B, and bi-sect same. Draw the perpendicular, C–D, the length being one-third that of A–B. Describe at A, circles showing diameters of small cone and at B one step of the other cone. Draw tangent a–b, and using D as a centre, describe a circle tangent to a–b. Tangent to the circle, draw the remaining tangents, c–d and e–f, and from them, using B as a radius, draw circles which will show the diameters of the remaining steps of the driving cone to be $19\frac{3}{16}$″ and $18\frac{5}{8}$″. The drawing should be well and accurately done, to secure close results. Any number of steps may be calculated by this method.

PROJECTION.

III. PRISMS.

A prism is a solid whose opposite ends are equal and similar plane figures; and whose sides, uniting the ends, are parallelograms. The ends of prisms may be either triangles, squares or polygons. A line drawn from the centre of one end of a prism to the centre of the other end, is called the *axis*.

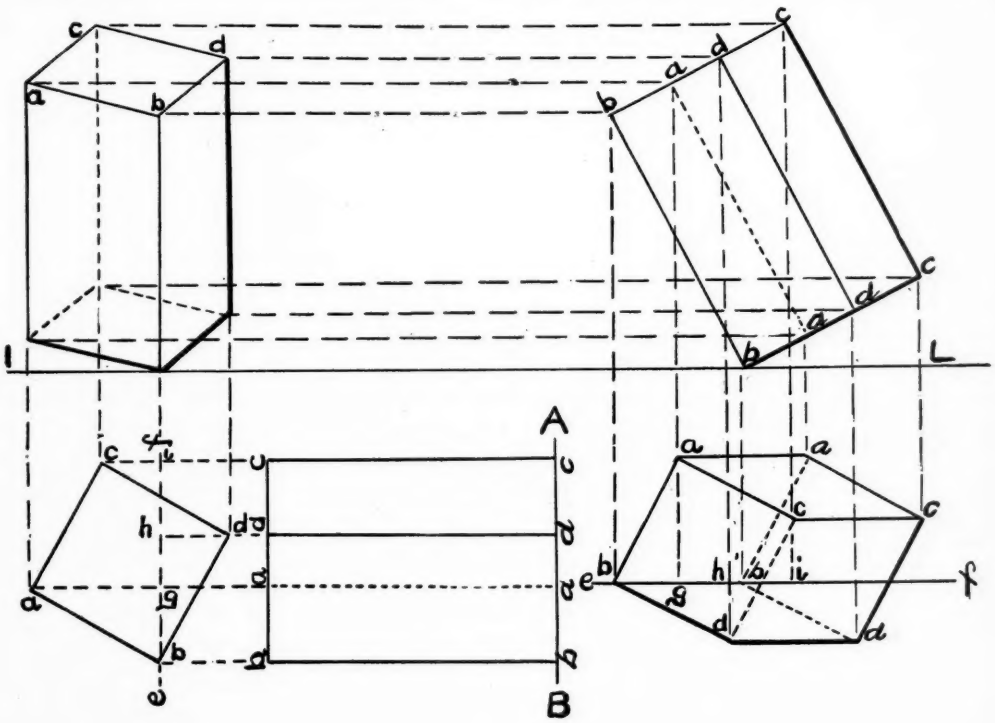


FIG. 14

As a square prism is merely an elongated cube, the examples given in the previous chapter may be worked but by the reader taking, in place of the cube, a square prism with sides three times as long as the width.

The following will make clearer the projection of inclined planes and enable the reader by the same process, to project views at any angle from either the vertical or horizontal planes. Assume that a prism, with length twice the width of the sides, stands on a plane inclined 25° from the horizontal plane and that the sides are at angles of 30° and 60° from the vertical plane. Draw the line of intersection, I–L. Under the left end draw the plan of the end plane at the required angles to the vertical plane. Draw at the right of this plan, a line, A–B, at right angles to the intersecting line. Draw intersecting lines from the points of the plan and the line, b–c, at the required distance from the line, A–B. It is evident that the figure thus obtained is the side elevation which can now be inclined at any desired angle. Above the intersecting line, at the right, draw the line, *b–c*, at 25° from the horizontal plane and then construct the elevation as previously secured,

thus obtaining the side elevation inclined at the required angle. The front elevation is obtained by drawing horizontal intersecting lines from the side elevation and perpendicular intersecting lines from the plan. With the points thus obtained the front elevation is easily drawn.

To obtain the full plan or top view, draw the line, e–f, parallel with the line, I–L, at a suitable distance below the latter, and then draw perpendicular intersecting lines from b–a–d–c of the side elevation. From the points where these lines intersect the line, e–f, obtain the points, g–a, h–d and i–c, by taking them from the plan of the end plane first drawn. It will be noted that the line, e–f, has been turned at right angles to the first position. Draw lines connecting points, a–b–c and d. From these points, draw lines parallel to the line, I–L and then draw perpendicular intersecting lines from *b–a–d–c* of the side elevation. The intersecting points of these lines and the parallel lines previously drawn are the points necessary to completing the plan. Accurate measurements and drawing will be found necessary to secure correct results.

To make a direct application of the foregoing lesson, project a table, the length of which is twice its width and height, standing on a plane inclined 30° from the horizontal and with the sides and ends of the table at angles of 30° and 60° from the vertical plane. Commence by drawing a plan of the top and from this develop the elevations in outline. It will then be comparatively easy to obtain the additional lines showing the thickness of the top and the legs, as though these were cut from a solid block of wood. Some of the intersecting lines are here omitted as the reader should gradually learn to dispense with full lines, using only short sections at the points where needed. This is not only a saving in time but, the drawing is then free from marks other than those actually required to secure clearness and accuracy.

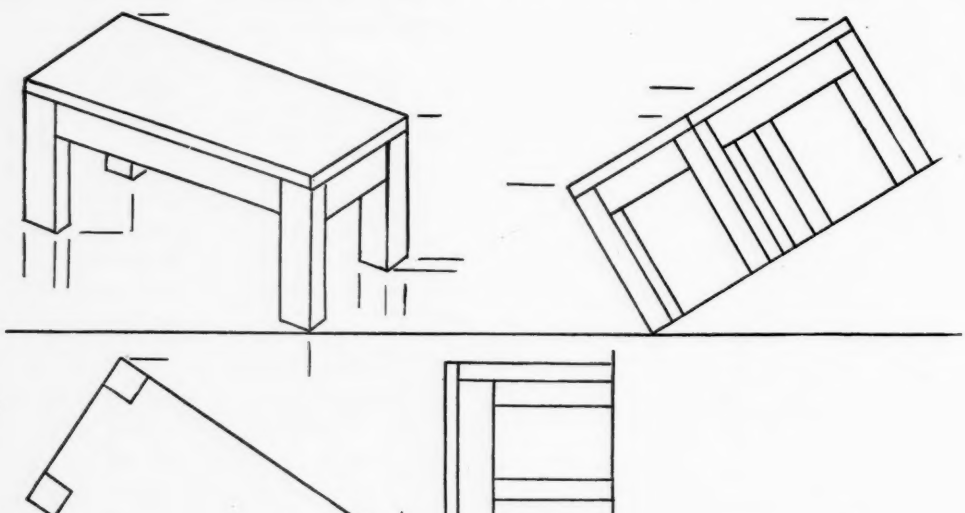


FIG. 15.

FINISHING NATURAL WOODS.

F. W. Putnam.

Until within a comparatively few years the processes used in finely finishing hard woods were all slow and expensive. Hence, the larger portions of hard woods used in furniture, musical instruments, buildings, etc., were allowed to pass without a proper finish, and the beauty of effect sought in the use of such woods was not fully obtained.

Our American woods were formerly so plentiful and cheap that their true merits were not properly appreciated; but now that they are becoming scarce and expensive, they are beginning to be most highly prized. Indeed there is scarcely anything in nature more beautiful than the variegated colors and grains of our woods when developed by a proper finish.

This development cannot be thoroughly accomplished except by the use of some material for filling the softer or porous parts with a hard transparent substance, and at the same time giving a smooth polish to the compact or solid parts, so that when varnish is applied it cannot strike into the wood and change its color. The varnish should merely lie smoothly upon the surface, giving brilliancy and effect to the natural beauty of color and endless variety of grain.

The correct principle of finishing all kinds of wood is to produce a perfectly smooth and elastic surface with as little varnish or other foreign substance as possible. To accomplish this, the surface of the wood must first be made even by filling the grain or pores to a plane with the solid parts with a hard, firmly fixed, and unchangeable substance. This being done, a little varnish will give the most desirable and durable finish attainable. Of course, the better the quality of the varnish, the more durable the finish.

Fillers.

As has been stated above, the grain or pores must be made even by filling the grain. For open grained woods such as oak, ash, etc., fillers are used rather than shellac. The filler usually comes in paste form. Its natural color is white, but when reduced with oil, turpentine, or benzine, it is transparent while moist. Colored fillers, which not only fill, but to a certain extent stain as well, can be bought at any paint shop, but as the smallest cans usually contain one pound, it often happens that the work in hand does not require nearly that amount. I shall then try to make clear the process of mixing the filler for various colors. The white filler is always taken as a base. I advise the use of Wheeler's No. 1 or Bay State white filler, as they are of the best on the market, and readily obtained.

Dry paints may be used as colors, or colors ground in pure linseed oil, such as raw or burnt umber, raw or burnt sienna, randyke brown, ivory black, golden ochre and bronze green. For the siennas buy if possible the best Italian.

It should always be borne in mind that no more color should be added to the filler than is absolutely necessary, as the addition of color does not improve the quality of the filler, but is liable to make it more or less absorbent. Very little color added to the filler, on account of its transparency, will give the desired result.

In using the filler it should be thinned down to the consistency of thin varnish, so that it will flow freely under the brush. The wood to be filled should first be made perfectly smooth, and finely sandpapered. But little more of the wood filler should then be applied than is required to properly fill the pores. In applying with the brush, work across the grain as much as possible, being sure that the pores are thoronghly filled.

As a rule, in a proper drying atmosphere, the wood filler will set, or become in the right condition for rubbing into the pores and off the surface, in from five to ten minutes, and no more surface should be covered than can be rubbed off in this time. When the filler has stood long enough to "dull down dead," a wad made of excelsior shavings should be used to rub the filler well into the pores. Rub crosswise of the work as much as possible. Be careful not to take any of the filler from the pores by rubbing too much with the grain. For natural finish, use clear white filler. For green finish, add golden ochre, lamp black, and, for very dark green, a little bronze green. The amounts of various colors added, must be governed by the taste of the worker, first trying the colors on waste pieces of wood.

White Wood.

For natural finish white shellac or a liquid filler is to be used. If a filler is used, for cherry color add burnt sienna and sometimes a little raw sienna. Handsome grained white wood can in this way be made to imitate real cherry very closely. For black walnut finish, add to the liquid filler burnt umber, raw umber, and a little lamp black. Sometimes a little burnt sienna is also added.

Carpenter, Norton Co., Sudbury St., Boston, manufacture a light transparent liquid filler for a first coating of white wood and hard pine, which takes the place of shellac, and which, with one coat of varnish, makes a fine finish. This filler can be colored as above mentioned.

Oak.

For natural finish use clear white filler. For the color shades, add colors such as, for green, golden ochre, and lamp black and sometimes dark bronze green; for brown, add burnt umber; for very dark brown, add lamp black, and sometimes raw sienna.

Mahogany.

For natural finish use clear white filler. For a darker finish add burnt sienna.

Cherry.

For natural finish use clear white filler. For darker finish add burnt sienna with a little raw sienna. For all the dark fillings, Wheeler's No. 3 or Bay State black walnut filler may be used as a base, and if a darker shade is wanted add burnt umber and a little burnt sienna.

As a rule the filler will dry sufficiently so that a second coat may be applied in a few hours. Two coats are generally sufficient, but the second coat after being rubbed off, must be allowed to dry perfectly before varnish is applied.

Oil Stains.

Very recently a fine grade of oil stains has been placed on the market, Wheeler's stains being among the best. One of the very best of these oil stains is the R. Y. Penetrating Golden Oak Stain, giving a color that is very satisfactory for oak furniture. A golden oak filler, thinned with turpentine, may be used to fill and stain at one operation.

In using these penetrating oil stains, the wood should be finely sandpapered previous to staining, and no further sandpapering is necessary. They will penetrate and stain without raising the grain. The stain is applied with a brush or a cloth. Using it more or less freely will color accordingly, that is, when used sparingly and wiped off at once, it will not color as deeply as if put on quite freely and allowed to remain ten or fifteen minutes before rubbing off. These stains readily wipe off from the surface, and after they have been wiped off, filling should be done the day following. The filler used should have as little coloring matter in it as possible. Wheeler's No. 3 Filler should generally be used.

Old Dutch Finish.

Fill the pores of the wood (preferably quartered oak) with filler of the shade desired. When the filler has had from eight to twelve hours to dry, apply one coat of Wheeler's Old Dutch Finish. Apply with a cloth, and wipe off clean as you go along, after which thoroughly go over the surface again with a dry cloth. This gives a dull dark finish with dark brown effect.

Water Wood Dyes or Stains.

There is a great demand for stains which will, as nearly as possible, make the poorer grades of hard wood in appearance match those of a superior quality. These stains are largely used to give to the wood the appearance of age. Mahogany continually improves in color; but as this takes time, there is a demand for a stain which will give this wood at once what has only heretofore been obtained in years. Bismark brown, dissolved in alcohol or water, is often used for a mahogany stain. Among the best of the Water Stains are the Breinig's Water Stains, manufactured by the Bridgeport Wood Finishing Co., New Milford, Conn.

English Oak.

To imitate English oak apply a heavy coat of Breinig's English oak water stain to the oak with a brush. When dry, sandpaper lightly with fine sandpaper. Nexl fill the oak with Wheeler's No. 3 Filler and finish with a light varnish. If a darker shade is desired, apply two coats of the stain. Sandpaper the first coat when dry, before applying the second coat of the stain. When it is desirous to have the quarterings show very light, the second coat of stain should be wiped off with a cloth before it has dried.

Alcohol Stains with Wax Finish.

Wadsworth, Howland & Co., Boston, make a number of oil stains which may be used with water stains to produce Austrian Oak, English Bog Oak, and Weathered Oak. I have finished several pieces of furniture with English Bog Oak, using first a coat of Austrian Oak Water Stain. When this is thoroughly dry, a coat of Oak Black Alcohol stain is applied evenly with a brush. The next day a wax finish is given and the furniture polished with a stiff bristled brush. I use the Bay State Wax Floor Polish, though any wax floor polish will do.

Mix the wax with enough lamp black to color the wax a bluish brown, and apply liberally with a rag, rubbing the wax across the grain. The wax will dull down in fifteen minutes, and is then polished with the brush just referred to, working first across the grain and then lightly with the grain.

This wax finish is very durable, cheap, and brings out the quarterings beautifully. This finish is especially desirable for the hall settle and the hall mirror recently described in this magazine.

Wadsworth, Howland & Co. also have stains giving a beautiful reddish brown color, so popular now for picture frames. The first stain is their Black Walnut Stain, followed with a coat of Flemish Oak Black Alcohol Stain, the former giving a much lighter finish than the latter. I would add that when these stains are used, nail holes must always be filled with wax colored with lamp black, as putty will not take either a water stain or an alcohol stain satisfactorily.

Weathered Oak or Wood Tint.

Besides the Weathered Oak stain manufactured by the Bridgeport Wood Finishing Co., there is a splendid stain made by the Chicago Varnish Co., 66 High St., Boston, Mass. One coat of this stain is applied with a brush, and is followed, when dry, by one very thin coat of Grain Alcohol White Shellac. A coat of Supreme Natural Finish is then applied, neither the shellac nor the Supreme Natural Finish being rubbed down.

This finish is very readily obtained, though some-

what more expensive than the finishes previously described, but will withstand the action of water and other liquids.

The United Crafts Company of Eastwood, N. Y., make a specialty of stains in the greens, the grays, and the browns. These stains are very readily applied, and are very durable.

A very good finish, which will deepen and become richer in color with age, is obtained by simply rubbing the surfaces, which have been previously filled and colored with wood filler, with a rag dipped in orange shellac and a little oil. This gives rather a dull finish, but one that is very smooth.

Varnish.

Finally we come to the varnish finish. Where a high polish is desired, the wood, after being thoroughly filled with wood filler, is covered with a medium coat of varnish. There are many kinds of varnishes on the market, some of which are quick rubbing varnishes. I do not like to use a varnish that becomes hard in less than a day, as it is apt to dry cloudy. When the first coat has become thoroughly dry, it is rubbed down lightly with pumice stone and oil or water, care being taken not to rub through the varnish. A second coat of varnish is then applied, this being a little lighter than the first. Care should be taken that the brush is used evenly with the grain. This coat is also rubbed down, and if satisfactory polish has not been obtained, a third coat of varnish is applied and so on. It should be remembered that three light coats of varnish will give a much better finish than two heavy coats.

All the above methods are to apply to new wood, i, e, wood that has not been stained or finished. When it is desirable to re-stain and re-finish wood which has been finished before, it is necessary to use other methods. Carpenter, Morton Co., Sudbury St., Boston, are the manufacturers of an article for this purpose, called "Campbell's Varnish Stains." These stains are, as the name implies, a combination of varnish and color which, when used on old varnished surfaces, makes a good imitation of different woods such as cherry, mahogany, walnut, oak, etc., without hiding the grain of the wood in the least. By using a varnish stain of this kind, the amount of time and labor saved is considerable as the staining and varnishing are done with one application.

Shellacs.

Fine grained woods are often given a shellac finish, especially when the wood is to be finished in its natural color, white shellac then being used.

Yellow shellac is made by dissolving yellow gum shellac in alcohol. Either wood (methyl) alcohol or grain (ethyle) alcohol can be used, though the latter is preferable. Wood alcohol is poisonous, so that shellac containing it should never be used as a protective coating for cuts or burns.

White gum shellac is practically colorless, and should always be used where the natural finish is desired. Fine grained woods that are to be finished in cherry, mahogany, or black walnut, are often stained and then finished with white shellac.

Application of Shellac.

In applying the shellac, the surface of the wood should be wiped clean and free from dust. This is especially necessary if the surface has been finished by sand papering. The first coat of shellac should be a liberal one, applied smoothly, and allowed to soak well into the surface. When the shellac is thoroughly dry, the surface will feel rough to the touch because the shellac has hardened any projecting particles or loose grains of wood.

The first coat of shellac should be rubbed smooth with a well worn piece of fine sand paper, care being taken not to disturb the general surface any more than is possible. The surface is then wiped free from dust and given another coat of shellac, the second begin lighter than the first. When thoroughly dry this second coat should be "rubbed down" with powdered pumice stone and oil or water, a rag being used for the purpose. Be careful not to rub through the shellac. In this way a fine polish can be obtained by the use of several coats of shellac. Several thin coats are better than a less number of thicker coats, but of course the use of thin coats requires more labor.

An Italian engineer named Piscicelli, so the news comes from Rome, has submitted to the minister of posts and telegraphy a unique scheme for the rapid delivery of mails. His plan is, essentially, to transport letters in aluminum boxes on overhead electric conductors. A commission has been appointed to report on the advisability of instituting an experimental line between Rome and Naples. Between these points the inventor claims he can deliver letters in twenty-five minutes.

The most convincing proof that there was nothing paradoxical in the action of the injector was given by Bourdon. This proof is of a purely experimental character, and is as follows: An air gun connected to a compressed-air reservoir has the open end of its barrel just opposite a valve opening inward in the said compressed-air reservoir. When the trigger is released, a bullet in the gun barrel will easily force the valve open and penetrate inside the reservoir. It is merely by momentum or vis viva acquired that the bullet overcomes the pressure in the reservoir. The same action takes place in the injector.

CORRESPONDENCE.

Our readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to Editor of Amateur Work, 63 Kilby Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if an answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

(No. 22.)

Amsterdam, N. Y., Oct. 22, 1902.

I have about completed a foot-lathe and find I have not made the driving wheel correctly. The steps of the cone on the spindle are 9-16 in. high and I made the steps of the drive wheel the same, but the belt will fit only on one step. I have asked a number of men how to lay them out so that the belt will fit each step, but am unable to get the desired information. Please give me the rule for laying out cones. N. H.

This inquiry is fully answered in another column. Readers of this magazine are invited to submit questions of this character which will be answered as quickly as possible. If an answer is wanted before publication, a stamp must be enclosed. The problems confronting one reader are quite likely to be met by others, and this department can be made of great value if readers but choose to help.

(No. 23.)

Somerville, Mass., Oct. 27, 1902.

In the September number, in "How to Make a Relay," it says to wind the magnets in opposite directions and connect the inside ends together. I tried this and could get no results, but re-wound one of the coils, so that both were wound in the same direction, and connecting the inside ends got excellent results. Kindly advise which is the correct way of winding. I have constructed a wireless telegraphy set and it works complete. C. R. S.

The directions as printed are incorrect, the error occurring in making a type written copy of the manuscript. The outer end of one coil should be connected to the inner end of the other when the coils are wound in opposite directions. The object in changing the direction of the wiring is to send the current around the cores in the opposite directions, thus securing poles with opposite polarity; one being positive and the other negative. A two coil magnet is the same, electrically, as a single coil bent in the center to a U shape. A simple way of keeping the winding correctly in mind is to wind a coil of paper on a pencil, bend in the centre and cut into two pieces, and holding the outer ends towards the eye, connect the ends which will send the current around one coil in the opposite direction from that of the other one.

(No. 24.)

New Dorchester, Oct. 27, 1902.

I am interested in the articles on mechanical drawing and have drawn many of the lessons. In the February number you show sectioning for different materials, B representing wrought iron and E representing steel. I am told that they should be the opposite from the way they are given.

Section lining, as stated in chapter, has no standard for the lining to represent a certain material. Every drawing room has its own standard. Other authorities use the lining mentioned above in the way stated by the writer, and the draftsmen follow the practice of the shop in which they work.

(No. 25.)

Salem, Mass., Oct. 29, 1902.

The following information may be of value to those engaged in electrical experiments. I have found that if the sal-ammoniac fluid is about evaparated and none of this salt at hand to renew it, common table salt may be used for the purpose. The latter creeps, but I use lard for coating the tops of the jars and have no trouble.

TRADE NOTES.

The Ohio Electric Works of Cleveland, Ohio, have prepared some very attractive outfits of lamps and batteries suitable for decorating Christmas trees. Six or more lamps complete with batteries and wired ready for the tree, are offered at 50 cents per lamp, assorted colors without extra charge. Red, pink, opal, frosting and crystal are mentined as being the most attractive. Readers interested in the preparation of Christmas trees should keep this in mind and order as early as possible.

The telephone parts advertised in another column by Frank S. Tucker, 1 Hartford St., Boston, are just what is wanted by those desirous of constructing telephones. All the necessary supplies can be purchased of him at very reasonable prices. Being a manufacturer of commercial telephones, the supplies obtained of him will be found reliable and durable.